**Testing Le Chatelier’s Principal:** Pre-Lab Exercises

Name

1. Assume that the following reaction is in chemical equilibrium:

N2(g) + 3H2(g)eqarrow 2NH3(g) + heat

Explain the effect of each of the following changes upon the system in terms of Le Chatelier’s Principle and a shift towards either the products or the reactant side.

1. More hydrogen is added to the system
2. Ammonia is removed from the system
3. Nitrogen is removed from the system
4. The temperature is raised
5. The pressure of the system is decreased by doubling the total volume

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| 2. Which describes a solution that contains a system at equilibrium? One in which the color of the solution is changing slowly, or one in which the color is not changing. Explain your answer. |
| 3. The following equilibrium is established when copper ions and bromide ions are placed in solution.  heat + Cu(H2O)6+2 + 4 Br- eqarrow 6 H2O + CuBr4-2  The tube on the left contains only copper sulfate dissolved in solution. The tube on the right is the result of adding some potassium bromide solution. Given that the Cu(H2O)6+2 ion is blue and that the CuBr4-2 ion is green, answer the questions below.  cubr   1. What happened to the concentration of each of the ions when the KBr was added? 2. Explain why the solution changed color. 3. Would the tube feel hot or cold when the KBr was added? |
| 4. Consider the following equilibrium.  Mg(OH)2(s) eqarrow Mg+2 + 2 OH-  The tube on the left contains Mg(OH)2(s) and water. A chemical has been added to cause the change shown in the tube on the right. Suggest a possibility for what chemical could have been added.  mgoh2 |
| 5. Methanol has the formula CH3OH and can be produced by the reaction of carbon monoxide with hydrogen gas.  CO + 2 H2 eqarrow CH3OH + heat  In an attempt to maximize the yield of methanol (amount of methanol produced), a chemist would try to shift the equilibrium as far to the right as possible. Which of the following would accomplish this?   1. Heating the mixture 2. Adding an excess of carbon monoxide 3. Removing the methanol as it is formed 4. Adding a substance that reacts with carbon monoxide |

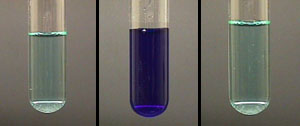
**Testing Le Chatelier’s Principal:** Post-Lab Questions

Name

1. Rewrite both chemical equations. Under each reactant or product write its characteristics such as colour.
2. In the first reaction, which direction did the equilibrium shift? What was the visual indication of this shift?
3. In the second reaction, which direction did the equilibrium shift? What was the visual indication of this shift?
4. Use Le Chatelier’s principal to explain the colour changes in each experiment.
5. The silver ion, Ag+, forms a colourless diamminesilver(I) complex ion, Ag(NH3)2+, that is soluble when it is in an ammonia solution. If ammonia is added to a solution that contains an AgCl precipitate, the solid dissolves completely. Write a net-ionic equation for the equilibrium involved, and explain the shift that takes place.
6. When concentrated H2SO4 (18M) is added to a saturated solution of sodium sulfate a white precipitate is formed. Write a net-ionic equation for the equilibrium in saturated sodium sulfate and explain the changes in terms of Le Chatelier’s principal.
7. A solution contains the blood-red hexathiocyanatoferrate(III) complex ion, Fe(SCN)63-, in equilibrium with the iron(III) ion, Fe3+, and six thiocyante ions, SCN-. If the solution is diluted with water, will the colour deepen, fade or stay the same? Why? Give TWO reasons for that prediction. One of those reasons will involve Le Chatelier’s principal, and one will not.
8. Consider the following equilibrium.

Cu+2 + 4 NH3 eqarrowCu(NH3)4+2

The copper ion in solution is light blue. The Cu(NH3)4+2 ion is a deep blue. The tube on the left contains only copper ions. Identify what chemical was added to produce the results shown in the center tube. Identify what chemical may have been added to the center tube to produce the results shown in the right tube.



1. The barium ion is toxic to humans. However, barium sulfate is commonly used as an image enhancer for gastrointestinal x-rays. What does this imply about the position of the equilibrium shown below.

BaSO4 eqarrowBa+2 + SO4-2

1. Hemoglobin (Hb) and oxygen gas form a complex (HbO2) that carries oxygen throughout the human body. Unfortunately, carbon monoxide also binds to hemoglobin so that equilibrium is established. Carbon monoxide poisoning occurs when the concentration of HbO2 in the blood is reduced.

HbO2 + CO eqarrowHbCO + O2

The first aid for a person suffering from carbon monoxide poisoning is to (1) remove them to an area of fresh air, and (2) administer oxygen. Using the principals of equilibrium, explain how each of these helps to restore the HbO2 concentration.

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